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WHEN MEASUREMENTS MATTER

South Africa: Cross-Campus Microclimate Mapping

Collecting real-time environmental data using a microclimate assessment rover

Abdul Ngcamu with the microclimate assessment rover platform

Overview

The Department of Soil, Crop, and Climate Sciences at the University of the Free State (UFS), South Africa, has long been a hub for cutting-edge agrometeorological research and training. Thanks to a longstanding collaboration with Campbell Scientific South Africa, students at UFS gain access to world-class instrumentation, technical mentorship, and real-world data-acquisition skills. This partnership continues to elevate student research and professional readiness in the environmental sciences.

In 2024, final-year student Abdul Ngcamu emerged as a standout researcher with his honors project focusing on Outdoor Thermal Comfort (OTC) on the UFS main campus. Abdul was awarded the Campbell Scientific Prize for Best Agrometeorology Student, recognizing his innovative work that integrated mobile sensing, fieldwork, and climate adaptation solutions.

Case Study Summary

Application
Using a mobile climate lab for student research

Location
Bloemfontein, South Africa

Products Used
LoggerNet, CR3000

Contributors
Prof. Weldemichael Tesfuhuney, University of the Free State

Participating Organisations
University of the Free State

Measured Parameters
Mean radiant temperature (MRT), Predicted Mean Vote (PMV), humidity index, Predicted Percentage of Dissatisfied (PPD)

The Challenge

As global temperatures rise, urban environments—particularly those with limited vegetation and high concrete coverage—are experiencing increased thermal stress. University campuses are no exception. Abdul's research focused on identifying how UFS's main campus outdoor spaces affect human thermal comfort, especially during high-temperature periods.

Key challenges included:

- Lack of dynamic microclimate data across various surface types and shaded areas
- Difficulty in assessing real-time comfort indices in a mobile, cost-effective manner
- Need for localized recommendations to mitigate heat stress through campus design

The Solution

Using advanced instrumentation from Campbell Scientific and with guidance from his supervisor, Dr. Weldemichael Tesfuhuney, and technician Ms. Nozindaba Radebe, Abdul designed and built a custom microclimate assessment rover. This mobile field platform allowed for real-time environmental data collection across diverse campus zones.

Instrumentation included:

- CS500 Temperature and Relative Humidity Probe for precise air temperature/humidity
- CR3000 Measurement and Control Datalogger, managed using LoggerNet software, for centralized data logging
- Anemometer for measuring pedestrian-level wind speed
- Kipp & Zonen net radiometers for solar and terrestrial radiation
- Thermocouples to assess surface temperatures on pavements, grass, etc.

Measurements were collected at six campus locations, including shaded, semi-shaded, and fully exposed areas. Data were then used to calculate multiple thermal comfort indices:

- Mean radiant temperature (MRT)
- Predicted Mean Vote (PMV)
- Humidity index
- Predicted Percentage of Dissatisfied (PPD)

These metrics provided a comprehensive picture of how different spaces on campus perform under thermal stress.

The Benefits

Abdul's project yielded tangible outcomes for both the university and the broader academic community.

For Campus Planning

- Identified hotspots of thermal discomfort with clear data evidence
- Offered practical recommendations such as introducing more shaded walkways, planting trees in strategic locations, and using reflective or porous surfaces to lower surface temps

For Student Training

- Demonstrated the power of combining theoretical learning with hands-on, data-rich experimentation
- Developed practical skills in field instrumentation setup, data acquisition, and climate analytics using Campbell Scientific tools

For Campbell Scientific

- Reinforced its role as a promoter of environmental education and innovation in Southern Africa
- Showcased how accessible, field-grade instrumentation can empower young scientists to design scalable, impactful solutions to local climate issues

The Project's Life-Altering Impact

A recent graduate in Agrometeorology from UFS, Abdul is currently completing a one-year internship at the South African Weather Service (SAWS). He aims to become a professional weather forecaster, continuing his journey in climate science.

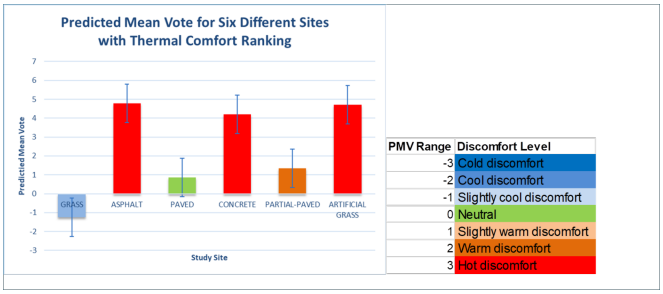
"This project allowed me to apply theory to real-world conditions. Building and using the MaR [microclimate assessment rover] platform was a great learning experience, especially working with Campbell Scientific sensors. I hope my findings can help make our campus a more comfortable and climate-resilient place."

— Abdul Ngcamu

Our thanks go out to Abdul, as we couldn't have summed this up better!

Map of campus measurement points

Students trained in field instrumentation installation



View online at: www.campbellsci.eu/south-africa-cross-campus-microclimate-mapping

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